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5 February 1969

MEMORANDUM FOR THE RECORD

SUBJECT: U-2R Lox System Meeting, 28 January 1969

REFERENCE: [ ] dated 22 January 1969

1. Subject meeting was held at LAC, Burbank, with the following participants present:

Headquarters

Detachment G

[ ]

[ ]

Lockheed Aircraft Corp.

ARO Corporation

[ ]

[ ]

2. The agenda for the meeting as presented by LAC is included as Attachment #1. The following discussion covers each of the agenda items.

a. History: [ ] presented only the recent history of lox system problems that led to the LAC modified system. The emphasis was on the several cases of zero pressures in flight on Aircraft 055 and 053 that occurred in early January. Specifically, it was explained how 055 was instrumented with pressure gages upstream of the checkvalves (i.e., measuring converter head pressure), while the cockpit console gages are downstream (i.e., measuring supply pressure). This aircraft was then flown again, and again experienced zero supply pressure. However, the converter pressure remained normal indicating that the check valve must have been stuck closed. The converter unit, including the checkvalve, was replaced, the aircraft flew again, and again experienced the same problem. This led LAC to attempt a modification of the existing hardware that would eliminate the check valve.

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b. Design Philosophy: [ ] presented the U-2R 25X1A lox system schematics, included as part of Attachment #2, and discussed the operation of the modified system. The main advantage of the system is that reliability is increased by the elimination of two mechanical valves (a pressure opening valve and the check valve). The possible disadvantage of the system is that it will probably operate at or near relief valve pressure (i.e., 100 to 120 psi) and the relief valve thus will act as a pressure control valve. Under questioning, [ ] stated that LAC saw no problems or disadvantages with operating the system in this way, and presented data showing no abnormal consumption (see O<sub>2</sub> useage rate chart in Attach. 2 and Attach. 3 data).

c. Flight Test Results: Attachment #4 presents pressure versus consumption data for all test flights utilizing LAC's RQ 1020 modified converter, with comparative data for unmodified PM 24500-1 converters. No exceptional information is found in these curves except that consumption seems normal for the durations and specific systems used by comparison to the unmodified converters. This same data was used to construct the summary chart included in Attachment 2.

d. Answers to [ ]: Generally, the questions 25X1A regarding flight test data were answered satisfactorily.

[ ] stated, however, that bench tests and failure analysis tests asked for, were not completed at that time. As soon as tests are run, LAC will forward data to Headquarters for review. Finally, questions regarding why the unmodified system gave us so many problems were left unanswered by LAC.

[ ] suggested that perhaps answers could never be obtained and wondered how far Headquarters wanted these questions pursued. The undersigned stated that the questions were only pertinent as the modified system might be affected by the same unknown factors that caused difficulties with the original converters. Many theories were proposed and discussed but generally no firm answers were provided.

e. General Discussions: Further discussions generally covered further aspects of the items previously discussed. However, ARO Corp. representative [ ] presented some additional information and points of view for the group's consideration. First

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25X1A [ ] pointed out that the LAC modified system would be satisfactory for U-2R use, as would the original system or a third system which ARO had proposed to LAC as a possible solution in Dec. 1968. 25X1A [ ] stated also that the LAC modified system presented nothing new or unknown, but represented a system which has been in existence for at least 5 years and used in such aircraft as the F-4. ARO Corp. had in fact sold 900 such systems and, had they been consulted by LAC, could have provided the necessary components for the modification as off-the-shelf hardware in lieu of LAC's machining of new parts. [ ] briefly discussed the system 25X1A his company had proposed to [ ] of LAC on 25X1A 16 December 1968. This system (schematic presented as Attachment #5) could also have been made from the original components with less effort and expense than the LAC RQ 1020 modification. [ ] stated 25X1A that he objected to having a control valve between the converter and the pilot, since he was concerned that the pressure control valve could fail closed resulting in the system pressure eventually reaching and staying at zero. However, [ ] stated that 25X1A the pressure control valve is designed to fail open only; therefore, the pilot would never have a zero pressure condition without a zero quantity condition.

f. L.A.C. Recommendations: LAC recommended that their RQ 1020 converter be used throughout the U-2R fleet in order to improve reliability and decrease oxygen problem incidence. [ ] stated that 25X1A turnaround of converters could begin immediately since LAC had produced enough hardware to outfit the fleet. Tech data would be available shortly after go-ahead was given. [ ] stated that 25X1A we would accept the system providing tech data is available prior to retrofit. The undersigned was to advise LAC, after obtaining USAF expert assistance, as to whether the LOX systems should be left in vent or build-up condition between flights.

3. Summary and Actions: As a result of this meeting, the following actions were and/or are to be taken:

a. Preliminary version of tech data to be furnished by LAC for review prior to retrofit of U-2R fleet.

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b. Bench test and failure analysis data to be furnished by LAC for review ASAP.

c. Undersigned to provide LAC with a final answer on USAF's policy regarding LOX system being left in vent or build-up between flights.

d. U-2R fleet to be retrofitted with RQ 1020 converters.

4. Conclusions: As a result of problems encountered, meetings held and actions taken over the past 5 months and personal observations made at Detachment G, LAC-Burbank, and ARO Corp., Buffalo, the undersigned has reached the following general conclusions regarding the U-2R LOX system:

a. LAC was justified in selecting the original system for use in the U-2R since it had performed exceptionally well in an almost identical installation in the A-12 and in a similar installation in the SR-71. However, in looking back to those installations it was found that the LOX system used was not "tailor-made" for these vehicles but was taken off-the-shelf, dualized for an increased safety factor, and used simply because it existed as a qualified system. The only change from off-the-shelf hardware involved using stainless tubing rather than aluminum due to the concern over high temperatures in the Mach 3 vehicles. Thus, it may be simply luck that few or no LOX problems were encountered in the A-12 or SR-71.

b. Advanced Development Projects of LAC-Burbank does not possess any significant expertise in oxygen systems or any other life support systems, for that matter, (except the ejection system per se).

[redacted] who has been used as a life support engineer on several ADP projects, lacks basic understanding of life support requirements. [redacted] who was called a LOX expert by [redacted] is a hydraulics oriented engineer with little or no basic understanding of life support requirements or systems. These conclusions are only presented because they help explain why LAC was unable to solve the U-2R LOX problems sooner, and why other life support type problems seem common, i.e., the air conditioning system.

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c. U-2R LOX problems prior to October 1968 were almost completely due to moisture contamination, since servicing and purging procedures, as specified by LAC tech data, were totally inadequate in preventing and eliminating moisture accumulation. Some early LOX problems were also related to a lack of specified servicing periods prior to flight, leading to LOX saturation. Again, this was due to a lack of LOX expertise at LAC.

d. ARO Corp. on several occasions attempted to help solve the U-2R LOX problems prior to October 1968, but were generally ignored. When they finally were officially brought into the problem solving group, they were too often not forceful enough in making their opinions, expert information, and proposed fixes known. ARO, completely on their own, set up and conducted extensive testing on the original LOX configuration, searching for causes of the problems. LAC concentrated on only one proposed fix at a time, whether it was a procedural or a hardware change.

e. LAC did very little testing or investigation to find causes for the problems, but concentrated on "cutting-and-trying" type fixes. This approach led to LAC modifying the checkvalves in the original system. This resulted in, for some unknown reason, an increased incidence of LOX problems which were also more serious problems. This increased incidence was then used by LAC as more evidence indicating that the checkvalve should be removed from the system.

f. The above conclusions are only presented to be made a matter of record for the benefit of subsequent individuals dealing with life support systems provided by LAC. The U-2R LOX system, as modified, will hopefully perform as advertised.

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